

staffs, when they have been trained in the universities, that the universities must later look for filling the professorships. A decrease, therefore, in the number and the quality of the non-professorial staffs of the universities means ultimately a decrease in the number and quality of the professors throughout the country. University teachers, particularly of professorial status, cannot be improvised or provided at a moment's notice. Competent professors are the result of attracting the requisite ability to the service of the universities in the junior grades and providing those junior grades with the opportunities for training in teaching and in research until they have reached the standard expected for professorial purposes. Unless, therefore, the universities are properly staffed, in a few years' time the whole standard of teaching and of research and of knowledge throughout the universities will inevitably drop; and it is desirable to remember that on the maintenance of the standards of the professoriate the training of the non-professorial staff largely depends.

Serious as is the situation to-day, its full meaning will not be apparent until some years hence, and it will then be impossible to make good what can be made good now, if we are not penny wise and pound foolish.

(2) Inadequate staffs, inadequate teaching, and overworked professors mean a drop in the quality of the students turned out by the universities. It is to the university-trained student that the Government, the municipalities, the schools, and the whole commerce and industry of the country must look for its *personnel*. If the universities are not doing their work up to the standard required, it is not the universities ultimately which will suffer most, but the whole nation. We shall be beaten as a nation because we shall be inferior as a nation.

The policy of the Government and of the local education authorities at present is to encourage, and rightly to encourage, the extension and the elevation of secondary schools in order to increase both the number of boys and girls to be kept on until they are eighteen years of age, and the number of boys and girls who will be fit to profit by a university education. What is the use of spending millions on adding to and improving the secondary schools throughout the country if the universities, which are the apex of this educational system, are to be starved? The secondary schools will be pouring out students which the universities will not be able to take; or, if they do take them, will not be able to give them a proper university education under proper teachers. Because you refuse to spend three millions, you will waste twenty or thirty millions.

Research in the universities, owing to the present congestion and inadequacy in numbers of the staff, is at present at a standstill; and unless steps are taken *now* to provide competent researchers, as well as a proper organisation and opportunities for research, the advancement of knowledge in Great Britain will come to an end. Organised research cannot be carried on anywhere except in a properly equipped university; and where industrial firms are carrying it on in a few specialised branches of industrial science from their own resources, they rely upon being provided from the universities with men and women fit to do the research required. It is not the business of, nor is it possible for, great firms to do the work of the universities in all the departments of knowledge.

The Government and the nation must make up their minds not so much as to whether the universities are to continue as to seeing that the universities are really universities and doing university

work. The funds cannot be provided from the tuition fees of the students. Seventy-five per cent. of the cost of maintaining a university must be provided from other sources than those of fees. I agree, therefore, with Sir Michael Sadler that while we welcome the additional half-million promised twelve months hence, another million and a half at least are required in order that the universities may be maintained on an adequate basis.

At Birmingham, as at Leeds, we need another 60,000*l.* a year in income in order to meet absolutely necessary expenditure.

C. GRANT ROBERTSON.

The University, Birmingham, August 13.

Aerial Navigation and Meteorology.

PROF. VAN EVERDINGEN's outspoken criticism in *NATURE* of July 22, p. 637, of the meteorological arrangements outlined in Annexe G of the Convention for International Air Navigation is very welcome. Prior to the war the International Meteorological Committee met every three years in friendly gatherings for social intercourse and the transaction of business. Broadly speaking, the difficulties of the members were in obtaining sufficient funds to enable them, in their respective services, to achieve the ends upon which they were agreed rather than in securing agreement on the desiderata for international exchange. Now that the former difficulties have been largely met as a result of the achievements of meteorology in the war, it would be calamitous if meteorologists failed to overcome the latter, and disturbed the unity of European meteorology at a time when their efforts ought to be directed to achieving unity in world-meteorology.

I am convinced that the scheme of Annexe G is a good one, and that a frank discussion of the details with the Continental meteorologists who were not present at the Peace Conference in Paris in May, 1919, would lead to the general adoption of the scheme with the slight modifications which experience of its working has indicated.

Prof. van Everdingen states that Annexe G was discussed at the meeting in London of members of the pre-war International Meteorological Committee. He has been misinformed. Permission to put Annexe G before that meeting was definitely refused. If such a discussion had been permissible, it would probably have removed many misapprehensions.

To take some examples from Prof. van Everdingen's article:

(1) He objects that in Appendix III. (apparently a misprint for Appendix I.) he finds "wind, temperature, and humidity in the upper air as additional and facultative." By "facultative" he means "optional." But Annexe G neither says nor implies that such reports are "optional." The exact words are: "Reports will give information on [wind, etc.], and also on upper air-currents and upper air-temperature and humidity from stations where facilities are available for observation." All standard meteorological stations are able to report wind, pressure, temperature, and weather phenomena three or four times daily all the year round; but only specially equipped stations can report upper air-currents, temperature, and humidity, and no station could in 1919, or can now, report upper-air information with the same frequency and regularity as standard stations report surface observations.

(2) Prof. van Everdingen states that the use of the telegraphic scale 1-72 means that an accuracy of 5° is claimed for surface wind direction. That is not so. In the past a scale of 1-32 has been nominally used (actually the

odd numbers are usually not utilised), but no one thinks that an accuracy of $11\frac{1}{4}^\circ$ is thereby claimed, and everyone knows that the exposure of the anemometer and the turbulence of the wind cause larger variations with space and time than $11\frac{1}{4}^\circ$. The scale 1-72 was adopted for the following reasons: Nearly all the observations of wind in the upper air are made by theodolites graduated in degrees and read to tenths of a degree (or exceptionally to minutes). The direction of the upper wind is obtained in degrees. Division of the number so obtained by 5 leads to the scale 1-72. It is much simpler than division by $11\frac{1}{4}$, which would lead to the scale 1-32. Moreover, the variation of wind direction with height cannot be indicated with sufficient precision by a scale 1-32. Also, the general practice in scientific work is to specify directions in degrees, and the practice is extending both at sea and in the air. The scale 1-72 is the most precise two-figure scale which is readily converted into degrees.

Whatever method is used for obtaining wind direction at the surface, the result can be telegraphed in the scale 1-72 without difficulty; if only the eight principal directions (N., N.E., E., etc.) are used, then only the corresponding numbers of the scale (72, 9, 18, etc.) will be used.

(3) Prof. van Everdingen objects to the use of two figures for reporting "weather." The need for an extension of the existing one-figure code has been apparent for a long time. A meteorologist at headquarters requires from a reporting station sufficient information to enable him to say with precision and certainty what the weather was at the station at the time of report. With the pre-war code for international exchange this was not done. A few drops of rain or a little drizzle were reported by the same figure as the most torrential downpour. A few flakes of snow or some fine ice-crystals were reported by the same figure as the heaviest snowstorm. No figure was provided for hail or sleet, and no indication given of the thickness of a fog (in past weather). A sky nearly covered with thin, white clouds at 20,000 ft. or 30,000 ft. was described by the same figure as the darkest, gloomiest day of the year. All this was due to the restriction of the pre-war code to one figure. It was not due to failure on the part of pre-war meteorologists to recognise the phenomena which ought to be recorded and the need for differentiation of intensity. *Practically the whole of the phenomena for which provision is made in the ninety-five figures of the code of Annexe G are included in the "hydrometeors" for which provision was made in Appendix I. of the fourth meeting of the International Meteorological Congress at Vienna in 1874.* Annexe G merely makes provision for reporting by telegram, at the time when it is of direct use, the information which the Congress at Vienna arranged should be written down and reported in *monthly returns* for later scientific investigation. As to the observer being puzzled, there will always be some occasions when he is required to use intelligence in deciding which number to select, whether the single-figure pre-war code is in use or the fuller two-figure code. The difficulty is minimised for him in Annexe G by arranging that all occasions on which precipitation occurs shall be reported by a number greater than 50. We have not found in actual practice the troubles which Prof. van Everdingen fears.

The severest criticism is directed against the inclusion of detailed codes in the Convention. Holland signed the International Convention for the Safety of Life at Sea in 1914; that Convention included detailed codes for meteorological reports. Meteorology is

more vital to the safety of life in the air than even ice reports to the safety of life at sea. The latter were made obligatory in 1914.

No one questions the *competence* of the International Meteorological Committee to fix the details of a code. That Committee must be in substantial agreement on the details of any code before it can be made generally obligatory. But at present the urgent need is for the trial of a scheme by the nations of Western Europe which is capable of being extended to the whole globe. The scheme of Annexe G is the only one in the field which provides both the general forms for meteorological messages and the detailed specifications necessary for reports to be made and interpreted in the confidence that their meaning is clear and definite, and that the information which they contain meets the present needs of an organised meteorological service. E. GOLD.

8 Hurst Close, N.W.4, July 25.

(1) COL. GOLD is not too well informed about the history of the International Meteorological Committee. The introduction of improvements in the reports and codes has often given rise to animated discussions; for example, when barometric tendency was introduced. It is true that the opponents remained friends, and that the minority co-operated in carrying out the resolutions, but that was a reason not to insist upon the introduction of a resolution which had been adopted by 7 votes against 6.

(2) There is at present no unity in European meteorology; it is no use to quarrel about who disturbed it; discussion of *various systems* by a competent body is the only way to restore it. I am very glad that the British weather reports for aerial navigation have modified already part of the codes of Annexe G. This certainly is a step towards reconciliation.

(3) The minutes of the meeting of members of the pre-war International Meteorological Committee held in London in July, 1919, at which both Col. Gold and I were present, contain a collection of codes almost identical with that of Annexe G. Col. Gold is right when he says that Annexe G was not discussed then, but that makes very little difference.

(4) Every standard station can report cloud motion or pilot-balloon observations. I am glad to state that cloud motion has now been introduced in regular British reports.

(5) The reading of the theodolite is accurate enough, but the direction of upper wind derived from the results is, in general, not accurate to less than 10° . A scale 1-36 is used in Holland and elsewhere. For scientific use a more accurate indication may be useful; for practical purposes it is useless.

(6) I only object to the way in which the two figures are combined for reporting weather; extension of the space for description of weather is welcome.

(7) My remarks referring to numbers to be used by observers in reporting phenomena are based on the practice *we* actually have had with the British reports.

(8) Annexe G can have its trial at the present moment if the Powers who signed it care. There are several other systems and codes being tried by various countries, and when these have had their course we shall be in a better position to decide what the present needs of an organised meteorological service are and how they can be met. E. VAN EVERDINGEN.

Koninklijk Nederlandsch Meteorologisch Instituut, De Bilt, August 9.